

## Water quality assessment of river Yamuna in Delhi stretch during Idol immersion

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### ABSTRACT

The manuscript deals with the assessment of water quality of River Yamuna during the idol immersion. Immersion of idols in the river during the festival season has become a cause for concern because of increased use of cheap lead and chrome-based paints in most of them. Increased use of plaster of Paris is not only affecting the humans and animals dependent on them but is also deteriorating the ecological condition of the river. During the immersion ceremony, puja articles such as polythene bags, foam cut-outs, flowers, food offerings, decorations, metal polish, plastic sheets, cosmetic items, all of which are highly polluting, are also thrown into the water. The sampling was done in three phases; pre idol immersion sampling, during idol immersion and post immersion sampling. The samples were collected from 13 different locations of the Yamuna along the Delhi stretch, primary sites for practicing idol immersion. The following parameters were analyzed to assess the quality of the river: Dissolved Oxygen, Biological Oxygen Demand, Chemical Oxygen Demand, Total solids, and pH. Methods prescribed by APHA were used throughout the work. The composed data was analyzed for the year 2011, to understand deterioration in the water quality of the river due to idol immersion practices. According to the results, the value of DO, BOD, Total Solids and COD were found to vary from 6.0-7.5 mg/L; 3.3-38 mg/L; 430-1268 mg/L; 28-136 mg/L respectively. The low levels of DO and high BOD and Total solids levels at different sites indicate the poor water quality due to idol immersions.

**Keywords:** Yamuna, Pollution, Idol immersion, Water quality, Immersion guidelines.

### 1. Introduction

Water is one of the essential requirements of life. In the modern age it also plays a significant role in various economic activities. It is also one of the most exploited natural resources. Most of the fresh water bodies all over the world are getting polluted due to domestic waste, sewage, industrial waste, agricultural and religious activities like idol immersion (Vyas *et al.*, 2007) (Figure 1).

River Yamuna, the main source of water supply to national capital-Delhi, plays a crucial role in its growth (Goel *et al.*). Total length of the River Yamuna from its origin near Yamunotri to its confluence with Ganga River at Allahabad is 1376 kilometer. The total basin area of the river is 366223 km<sup>2</sup> which covers part of geographical area in the states of Uttaranchal, Uttar Pradesh, Himachal Pradesh, Haryana, Rajasthan, Madhya Pradesh & NCT – Delhi (CPCB, 2006). The 22 km stretch in Delhi, once described as the life line of the city, today has become one of the dirtiest rivers in the country (Mishra, 2010). Idol immersion is one cause of water pollution in the river Yamuna as it is widely worshipped by devotees in India.



**Figure 1:** Idol of Goddess Durga being immersed in the river on the occasion of Vijaya Dashmi at Kalindi Kunj, Delhi.

In India, since ages, there has been a strong interrelationship between religion, customs, rituals and divine rivers. These pious rivers are worshiped right from the time any person takes birth to its death, the entire rituals and ceremonies are associated with these rivers (Singh, 2009). The immersion of idol of Lord Durga during Navratris festival is a major source of contamination and sedimentation to the lake water (Figure 2).



**Figure 2:** Idol immersion activity being carried out within the enclosures, set up under the guidance of state board and the Central Pollution Control Board, at Nizamuddin, Delhi during the occasion of Vijaya Dashmi.

The toxic chemicals used in making the idols tend to cause serious problems of water pollution and also pose a serious threat to the underwater ecological system. When immersed, these colors and chemical dissolve slowly leading to significant alteration in the water quality (Dhote et al., 2001). The idol immersion is a religious activity, which is responsible for adding pollution load in the river (Figure 3).



**Figure 3:** Post idol immersion debris along the Haathi Ghat, downstream of the river Yamuna, which chokes the river.

## 2. Materials and methods

A number of religious activities take place every year, which affect the water quality of upper and lower lakes. The festival of Durga idol immersion is observed once a year. Durga immersion, though it is not celebrated in Delhi at a large scale but its celebration in some pockets have lead to heavy pollution in Delhi stretch of river Yamuna (CPCB, 2006). Thirteen sites were selected in the Delhi stretch where the immersion activity is done (Table: 1).

**Table 1:** Thirteen study sites along the river Yamuna stretch where idol immersion takes place with the river flow.

Site No	Idol immersion Site	River Stream Flow	Parameters analyzed	Range	Remarks/Pollution Level
S1	Thokar No. 8	Upstream	pH, DO, BOD,COD, TSS	pH-5.5-9.0 DO-4 Minimum BOD-3 Maximum Limit	Moderate
S2	Thokar No. 12	Upstream			Low
S3	Ram Ghat u/s of Wazirabad	Upstream			Low
S4	Sonia Vihar U/S of Wazirabad	Upstream			Low
S5	D/S of Wazirabad	Upstream			Low
S6	Garhi Mandoo	Upstream			High
S7	Majnu Ka Tila	Upstream			High
S8	Khudesia Ghat	Upstream			High
S9	Geeta Colony	Downstream			Low



S10	Haathi Ghat	Downstream			High
S11	Nizamuddin	Downstream			Moderate
S12	Kalindi kunj	Downstream			Moderate
S13	Okhla Barrage	Downstream			Moderate

The water samples were collected from surface layer from the site of idol immersion at different intervals i.e. pre immersion, during immersion and post immersion. Pre idol immersion samples were collected three days before the commencement of the immersion activities. During idol immersion samples were collected during the immersion activities. Post idol immersion samples were collected two days after the completion of immersion activities. The samples were subjected to various physio-chemical analysis and were analyzed according to standard methods (APHA, 1995). The parameters namely pH, BOD, COD, DO, and TSS were analyzed. Figure 4 shows the map of the selected sites.

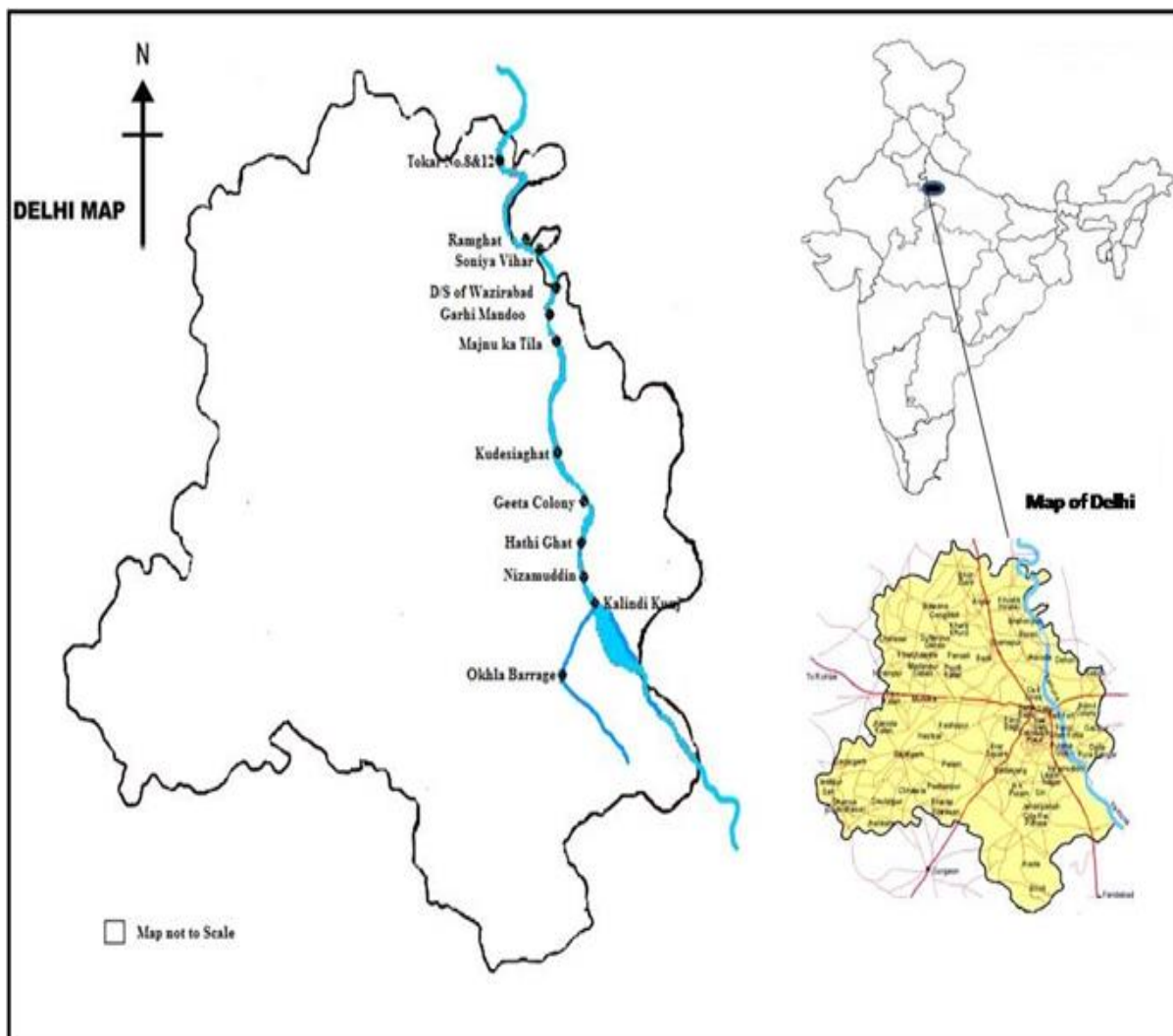


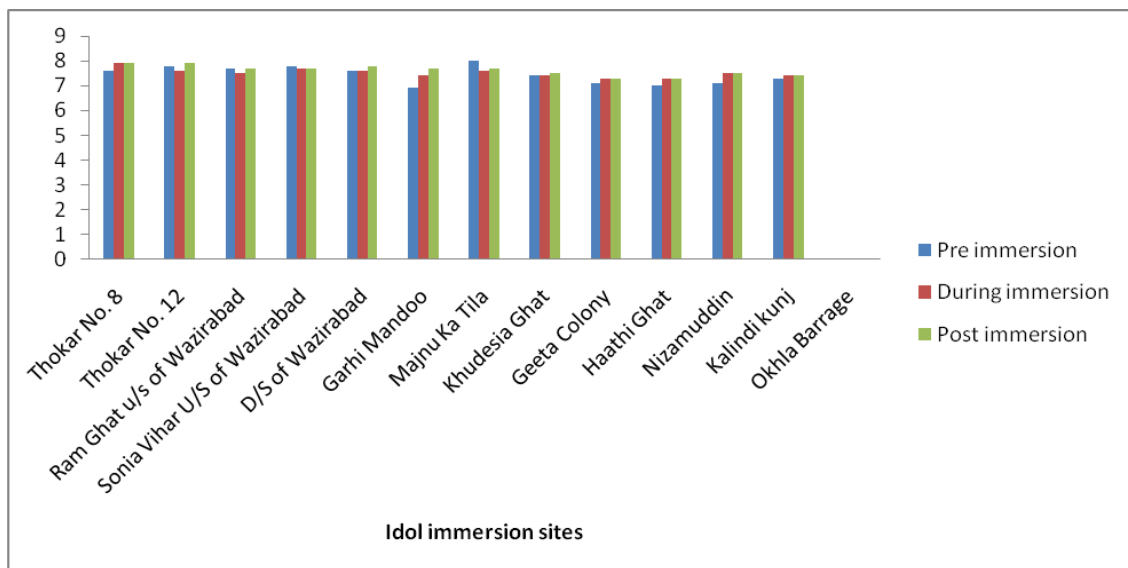
Figure 4: Map of the study area

### 3. Results and discussion

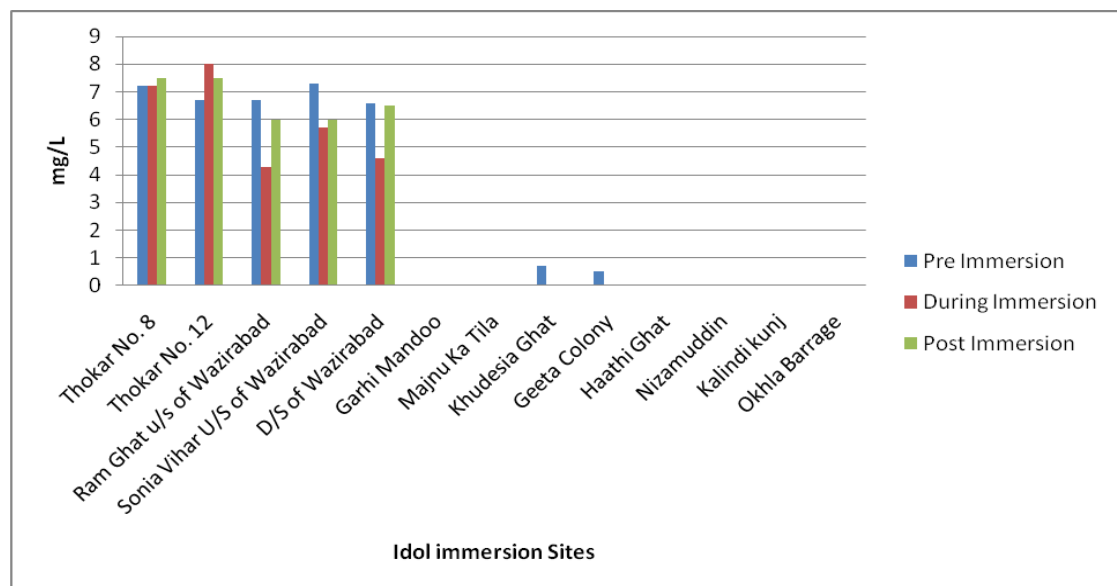
The results of research work have been depicted in (Table: 2) and Figs. 5,6,7,8 and 9.

**Table 2:** The sequence of data shown in table is minimum – maximum (mean ± standard error)

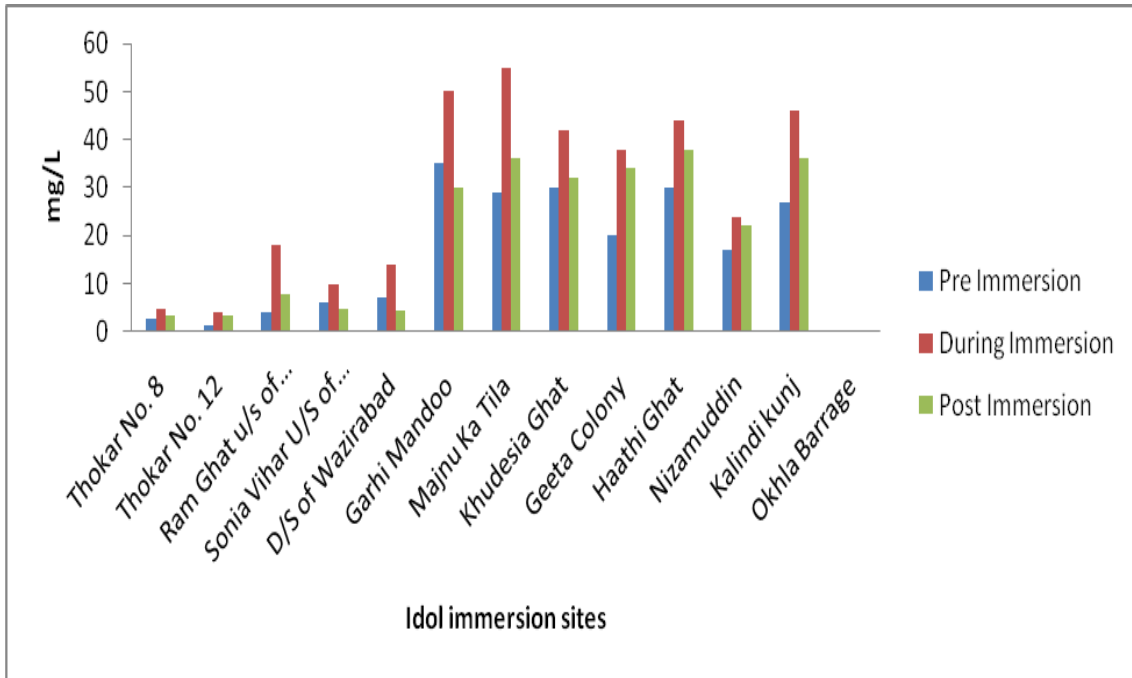
Parameters	Pre immersion	Immersion	Post immersion
Ph	6.9-7.8 (7.4±0.360)	7.3-7.9 (7.5±0.174)	7.3-7.9 (7.6±0.212)
Dissolved Oxygen (mg/L)	0.5-7.3 (5.1±0.141)	4.3-8.0 (5.9±1.610)	6.0-7.5 (6.7±0.758)
BOD (mg/L)	1.4-35 (17.433±12.605)	4.0-55.0 (29.141±18.655)	3.3-38.0 (20.983±14.906)
COD (mg/L)	16-124 (75±40.760)	32-188 (109±54.556)	28-136 (84.666±45.66)
TSS	294-1366 (756.5±321.906)	494-1264 (806±287.991)	430-1268 (776.116±308.069)



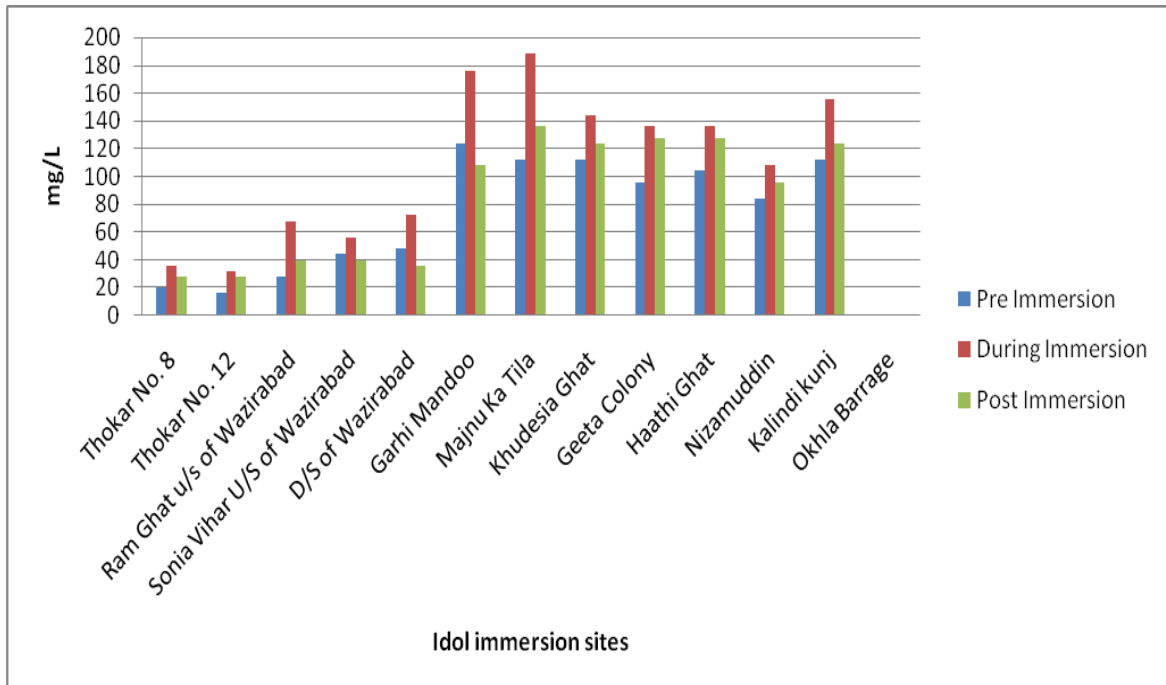
**Figure 5:** Variation in pH at various sites during pre, during and post immersion activity.



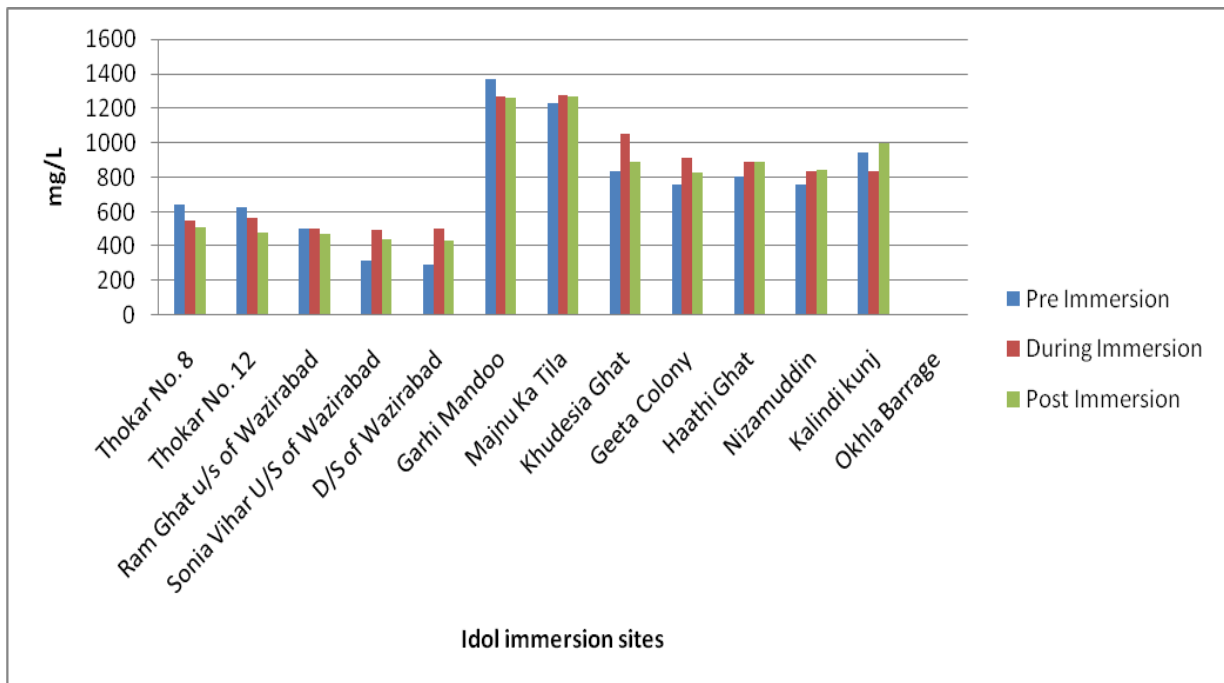
**Figure 6:** Variation in Dissolved Oxygen (DO) at various sites during pre, during and post immersion activity.



**Figure 7:** Variation in Biological Oxygen Demand (BOO) at various sites during pre, during and post immersion activity.



**Figure 8:** Variation in Chemical Oxygen Demand (COD) at various sites during pre, during and post immersion activity.



**Figure 9:** Variation in Total Suspended Solids at various sites during pre, during and post immersion activity.

The data indicate deterioration in water quality of all the thirteen sites selected for the study. The sites that showed high level of water pollution are Site-8 (Khudesia Ghat), Site-10(Haathi Ghat), Site-3 (Ram Ghat) and Site-4 (Sonia Vihar). The pH ranged from 6.60-7.9, though it did not show any major fluctuation. But, the Post idol immersion data shows slight increase compared to pre idol immersion data. The pH of water is important as it governs solubility of nutrients (Ujjania *et al.*, 2011). A range of 0.5-7.3, 4.3-8.0 and 6-7.5 mg/L were obtained from the thirteen sites during the pre-during and post idol immersion for DO. The maximum value of DO observed during idol immersion is at S1 and S2 are 7.2-8 mg/L. Its value was found to be Nil during immersion period at seven sites from S-6-S-13. The low or nil values could be due to higher consumption of DO by microbial activities. DO is the most important parameter to study the quality of water and is required for the metabolism of all aquatic organisms was found to be Nil at seven sites (Tamot *et al.*, 1998).

Biological Oxygen Demand represents the quantity of oxygen which is consumed in the course of aerobic processes of decomposition of organic materials, caused by microorganisms. The BOD therefore provides information on the biologically-convertible proportion of the organic content of a sample of water. This leads to the consideration of these materials in terms of their susceptibility to oxidation by the use of oxygen (Aqua Lytic, [http://dl.aqualytic.de/studies/importance\\_aqua\\_gb.pdf](http://dl.aqualytic.de/studies/importance_aqua_gb.pdf)). The range of 1.4-35, 4-55 and 3.3-38 mg/L were obtained from the pre, during and post immersion activities. The maximum value of BOD was observed during the immersion period at Site-7 (Majnu Ka Tila). The COD which is commonly used to indirectly measure the amount of organic compounds in water was also analyzed. Most applications of COD determine the amount of organic pollutants found in surface water (e.g. lakes and rivers) or wastewater making COD a useful measure of water quality. The value of COD in conjugation with BOD is helpful in knowing the toxic conditions and presence of biologically resistant organic substances as also reported by (Rajkumar *et al.*, 2003) and (Gupta *et al.*, 2011). The maximum value of COD was found to be 188mg/L at Site7. The Total Suspended Solids (TSS) levels were high at Site6 and

Site7 in the pre, during and post immersion period. High concentrations of suspended solids lower water quality by absorbing light.

#### **4. Conclusion**

The present study on assessment of idol immersion on physic-chemical characteristics of river Yamuna in Delhi stretch revealed that idol immersion activity has negative impact on water quality of river Yamuna. Immersing idols in rivers is an age-old tradition which poses a grave threat to water bodies. During the Hindu festive season, hundreds of idols of God and Goddess are immersed in the rivers polluting the river's eco-system. The possible ways of dealing with this grave problem is by creating awareness among the masses. The lack of awareness among our people is the main reason behind such an environmental pollution. Environmental awareness campaigns and meetings should be organized to make public aware of environmental damage caused due to immersion of idols into the river system. Different communication media may serve as a useful tool for such a campaign. A Co-ordinated Committee comprising Police, Non-Government Organization, Local Authorities, State Pollution Control Boards, representatives of pooja committees and stakeholders should be set up for guiding the public in carrying out the immersion with minimal impact on water bodies.

Central Pollution Control Board has formulated a comprehensive set of guidelines on the practice of idol immersion in lakes, rivers and seas (*CPCB, Guidelines for Idol Immersion, 2006*). These guidelines delineate and specify the role of the state pollution control boards in conducting water quality assessments of water bodies and classifying them on the basis of certain physio-chemical parameters. These guidelines if followed and acted upon can help in bringing tremendous change in the water quality of river post idol immersion. Some alternatives that can prevent the further deterioration of the river during immersion period:

The water and debris flowing through this marked area can be collected and treated with technical measures. This filtered water can be allowed to flow back into the river.

1. A ban on synthetic paints used for coloring the idols can be made regulatory and the Pollution due to immersion can be reduced due to great extent.
2. An alternate model for the idols can be developed and it should be free from pollution or contamination of water.
3. Educating the public about using smaller (token) idols and the manufacturers of idols about using eco-friendly material.

Lastly, human intervention is very important to tackle this alarming issue and certain regulations should be formulated with the consensus of religious and welfare organizations as they can reach out to masses more powerfully.

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